blackish-grey, with some silvery reflections. *Legs* (Text-fig. 7) blackish, with creamy-yellow hairs on femora and parts of tibiae; calcipala prominent, about two-thirds width of metatarsus; claws with large tooth. *Wings* clear, veins dark brown, halteres with grey stem and creamy knob.

Abdomen with first segment dark grey, dull yellowish apically, with creamy-yellow hairs. Remaining segments generally dark grey, paler at the apices of segments, with rather scattered, short, creamy-yellow hairs, especially posteriorly, and with velvety-black tergal plates, those on 2nd, 3rd and 4th segments entirely black, 5th with small patch of ashy tomentum in its centre, 6th and 7th with progressively larger ashy central areas, reducing the black to lunulate patches on each side, 8th and 9th entirely ashy.

Male.

Head. Antennae with basal two segments black; second larger than third; remainder dark grey, with fine silvery hairs. Palpi and mouth parts black.

Scutum velvety-black, with rather dense golden hairs. Pleurae dark grey, with silvery reflections anteriorly. *Wings* clear, veins black. Halteres with stem and basal half of knob black, distal half of knob dull yellowish-brown. *Legs* entirely greyish-black. Hind metatarsus appears to be as long and as wide as the tibia. Calcipala broad.

Abdomen dark grey. Fringe of first segment black. Tergites velvety-black (somewhat like the female of *furiosum* and more restricted than in *victoriae*), except the ninth, which is grey, and a variable hint of an ashy band at the edges of tergites 2 to 5 or 7. Venter grey. Hypopygium very like that of *A. cornutum*. Style with two terminal spines; anterior part of phallosome broadly oblong, with the usual setulose, ventral convexity; posterior part with a row of fine denticles, which are smaller and more delicate than those of *A. crassipes*; median piece not detectable.

Cocoon.

Length 3 mm. There is considerable variation in the form of the cocoon. The majority from the type locality and Barrington Tops were in the form of a long oval with a very low collar, a slight, rounded, central-dorsal projection, and a neat rolled edge (Text-figs. 10, 11). However, cocoons from Victoria were remarkably like those of *A. victoriae* (Roub.) from the same locality, having a long central dorsal horn, which curved forward and downwards (Text-fig. 8). Others from Victoria were intermediate in structure (Text-fig. 9), and one from Ebor had a well-developed "horn" like the Victorian specimens.

Although the finished products of the two species look alike, the methods of production evidently are different, and "horned" cocoons of *A. victoriae* are easily distinguished from those of *A. montanum*. In the former the "horn" is evidently made by prolonging the central thickened ridge, whereas in *A. montanum* there is no central thickened ridge and the "horn" appears to be continuous with the anterior rolled edge. The "hornless" varieties are not readily separated.

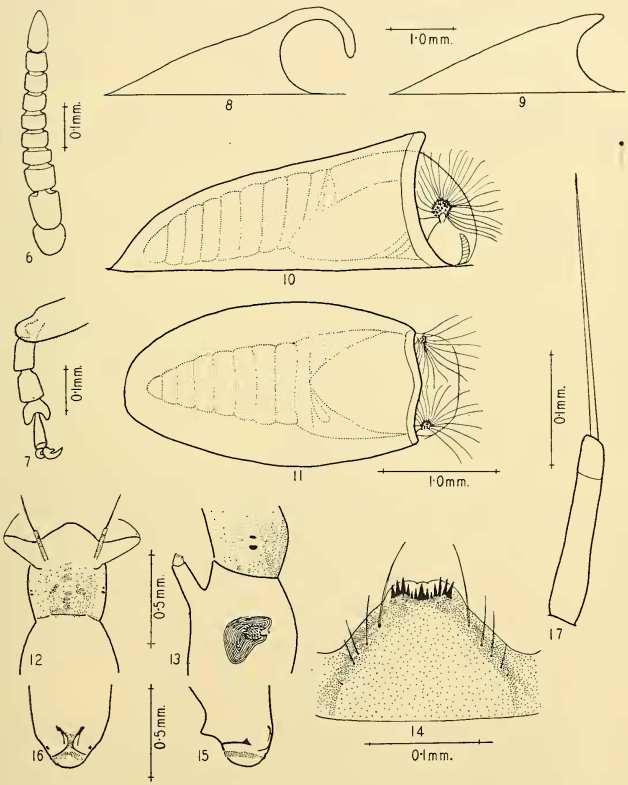
Pupa.

Length 3 mm. The cephalic and thoracic integument is marked by numerous minute, irregular ridges. The thoracic hairs are well developed, the three posterior dorso-central pairs being stiff and sharply pointed. The respiratory organ consists of a very short, rounded, flattened horn, which is covered with strong, black spines. The filaments are fine and numerous, arise chiefly from the margins, and spread out in all directions (Text-fig. 10).

The abdomen resembles that of some other members of the group in having spines on the ventral surface. There are the usual fine hairs on the first and second tergites, and four pairs of strong subapical hooks on the third and fourth tergites. Ventrally, there are two pairs of sharp, forwardly-directed spines placed close together on the fifth sternite, and two pairs of similar spines widely spaced on the sixth and seventh sternites. There are also stiff curly hairs laterally on these segments. The ninth segment bears small terminal hooks and a bunch of curly anchoring hairs laterally.

Larva.

Length 5·5 mm. Light creamy colour, with brownish or greyish markings. The head pattern consists of a dark central stripe, which is interrupted in the middle, and a dark patch on either side at the level of the eyes (Text-fig. 12). The basal segment of the antenna is usually brown, the shade varying from light to dark brown. The indistinct division of the basal part occurs near the distal end, as in other members of the group. The basal is more than half the length of the slender apical segment (Text-fig. 17). The submentum is armed with 13 teeth, of which the central and the



Text-figs. 6-17.—*Austrosimulium montanum*, n. sp.

Adult female: 6, antenna; 7, hind leg.

Cocoon: 8, "horned"; 9, intermediate; 10 and 11, "hornless".

Larva: 12, dorsum of head; 13, gill-spot; 14, submentum; 15 and 16, posterior ends; 17, antenna.

third from each side are the largest. The central tooth does not project beyond the rim of the sclerite. There is a very minute tooth third from the mid line. The rim of the sclerite is distinctly indented at each side of the central tooth (Text-fig. 14).

The gill-spot shows the short, rounded horn covered with black spines; the filaments sweep downwards and slightly backwards, and then curve forwards and upwards (Text-fig. 13).

The rectal gills are simple. The anal sclerite is similar to that of other members of the group. The ends of the chitinous ring are slightly expanded (Text-figs. 15 and 16).

Biology.

Larvae and pupae were found attached to vegetation in swift, cold streams on the Dorrigo Plateau in company with *A. victoriae* (Roub.) and *A. furiosum* (Sk.). In Victoria they were taken in moderately fast water in company with the same species as in New South Wales. Habits of the adults are unknown.

Distribution.—New South Wales: Coutt's Water and smaller streams near Ebor, Dorrigo Plateau, 4,000 ft., September–October; Barrington Tops, 4,500 ft., March (McMillan). Victoria: Sassafras, February; Narbethong, October–November; Acheron River, Buxton, October–November.

AUSTROSIMULIUM CRASSIPES Tonn.

New distribution.—New South Wales: Waterfall on Dorrigo Mt., October; Barrington Tops, 4,500 to 5,000 ft., March (McMillan); Cooranbong, February (McMillan); Warrah Field Station, Hawkesbury River, July–August (McMichael).

AUSTROSIMULIUM BANCROFTI (Tayl.).

New distribution.—Victoria: Small tributary of Murray River, west of Merbein, December. (Not previously recorded from this State.) Also taken on dogs, man and rabbits in southern New South Wales (Myers).

AUSTROSIMULIUM FURIOSUM (Sk.).

Distribution.—As noted in earlier papers, the distribution of this species is extremely wide. It was included in the collections from almost every locality in New South Wales and Victoria mentioned in this paper. In one instance, an adult was collected in a rabbit warren near Deniliquin (Fennessy), and it has been taken biting man, horse, cattle, dog and rabbit in other localities in southern New South Wales (Myers) and northern Victoria (Fennessy).

AUSTROSIMULIUM VICTORIAE (Roub.).

We have been able to collect satisfactory material of this species recently in Victoria. The type locality is "Mountains of Victoria", and the type series (which included one *C. umbratorum* Tonn.) was collected by the late C. French in 1899. Mr. R. T. M. Pescott, Director of the National Museum, Melbourne, has informed us that Narbethong in the Blackspur Range was a favourite collecting ground of French at that time, and that it was as far afield as the old Field Naturalists' Club, of which French was an enthusiastic member, could conveniently go. Recently, we found *A. victoriae* abundant and obtrusive at Narbethong, in company with a few *C. umbratorum*, and French may well have had a similar experience. Narbethong would therefore seem to be as near the type locality as can be guessed.

The Narbethong material consists of adult females, larvae and pupae, and is supported by considerable series of all stages from various localities in high country through New South Wales to South Queensland. Our earlier confusion was due to the fact that the cocoons of Tonnoir's Canberra material were all fragmented, and we failed to understand his notes. A redescription of the early stages is therefore desirable.

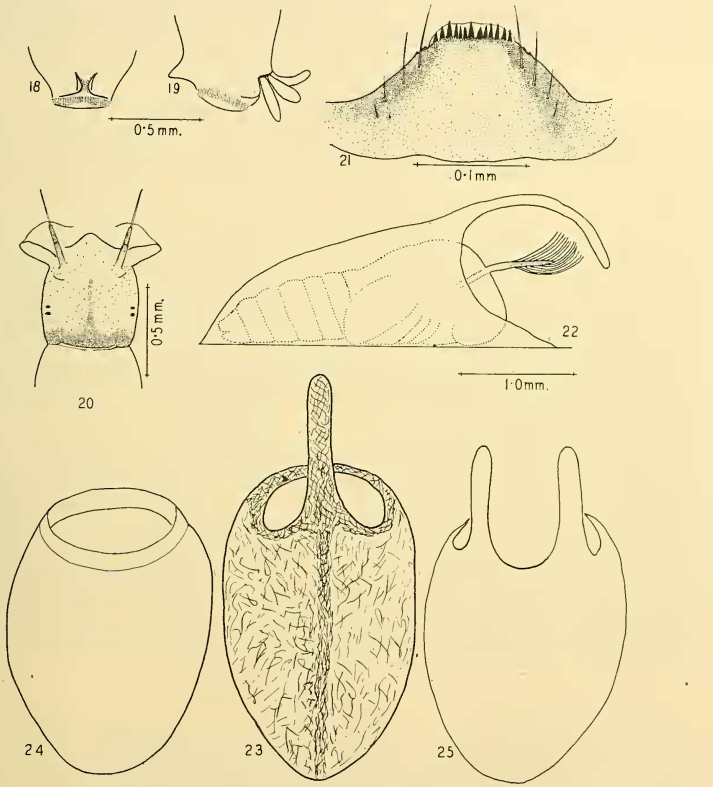
Larva.

Length 5 to 6·5 mm. Pale creamy-yellow, with greyish-brown mottling. Some individuals from shaded water were extremely pale, except for the dark basal part of the antenna. Well-developed ventral papillae present (Text-fig. 19).

The pattern on the dorsum of the head varies considerably, but basically it consists of a fairly broad basal band of dark brown and a narrow inconspicuous central streak (Text-fig. 20). Some very pale individuals had scarcely any pattern, while others were so heavily pigmented that the pattern was obscured. The stout proximal segment of the antenna is dark brown and indistinctly divided about its middle; it is the slender

apical portion which projects beyond the basal piece of the fan (Text-fig. 20). Submentum as in Text-figure 21.

The gill-spot consists of a strong, narrow horn, yellowish at the base, and covered with flat, dark tubercles on the more distal part, from which the filaments spring. The filaments arise from the sides and outer surface, and curve round anteriorly. The posterior circlet is well developed, having about 90 to 100 closely set rows, each containing about 15 spines.



Text-figs. 18-25.—*Austrosimulium victoriae* (Roub.).

Larva: 18 and 19, posterior end; 20, dorsum of head; 21 submentum.

Pupa and cocoon: 22, lateral view of pupal respiratory organ and "horned" cocoon.

Cocoons: 23, with central dorsal "horn" (New South Wales and Victoria); 24, "hornless" (Queensland); 25, with double "horn" (Tasmania).

Pupa.

The head is covered with small, flat tubercles, rather uniformly arranged, and leaving a symmetrical ⊥-shaped pattern of bare spots. The cephalic hairs are long and fine.

The thorax is covered with small, flat tubercles, arranged in tiny rosettes over that part of the thorax which is exposed. The more posterior covered part is decorated with smaller, flat tubercles uniformly arranged. The last pair of dorso-central thoracic hairs

is modified to form a pair of minute, forwardly-directed hooks; these occur just at the junction of the exposed and unexposed portions of the thorax. The other thoracic hairs are long and fine. The respiratory organ consists of a moderately short, narrow, flattened horn, covered with flat, dark tubercles. The filaments are fine, and arise chiefly from the sides and external surface of the horn (Text-fig. 22).

The first and second tergites of the abdomen each bear five pairs of fine, pale hairs; the third and fourth bear four pairs of strong, forwardly-directed subapical hooks; the fifth to the seventh have fine, stiff, curved hairs, with the points directed forward, the eighth has curly lateral hairs; and the ninth bears the usual strong hooks and bunch of curly anchoring hairs on each side. The ventral surface appears to be bare.

Cocoon.

All those from Victoria and southern New South Wales have a long, median dorsal projection, the Queensland ones have no projection, and the two forms occur together on the Dorrigo Plateau. The Tasmanian race, originally described by Tonnoir as *A. tasmaniense*, is remarkable in making cocoons with two long projections (Text-figs. 23 to 25).

The races of A. victoriae.

The adults bred from the three types of cocoons are indistinguishable. The larvae associated with them are also indistinguishable, except that the southern forms tend to be larger. The pupae are also very similar, except that those from Tasmania have a longer respiratory horn and the gill-filaments are bunched together and directed medially. We have hesitated to resurrect Tonnoir's name, although it is available if subspecific separation ultimately proves to be desirable. The confusion has arisen because the Tasmanian cocoon is so distinctive, and because no less than three mainland species (*A. victoriae*, *A. cornutum* and *A. montanum*) frequently make cocoons with a single, long, median, dorsal projection.

Distribution.—Tasmania: Localities given in earlier paper (Tonnoir). Victoria: Narbethong (? *type locality*), Buxton, Marysville, October–November; Sassafras, October; Mt. Buffalo, October (Tillyard and Currie); Tarra Falls, January (Sandars). New South Wales and A.C.T.: Deniliquin, in rabbit warren, November (Fennessy); Mt. Kosciusko, December; Black Mountain, Cotter River, Blundell's, etc., September–November (Tonnoir and others); Wentworth Falls, March (Wharton); Mt. Solitary, Jamieson Valley, September (McMillan); Lett River, Hartley, October; Williams River, 1,500 ft., March (McMillan); Barrington Tops, 4,000 to 4,500 ft., March (McMillan); Dorrigo Plateau, near Ebor, approx. 4,000 ft., September. Queensland: Little Nerang Creek, September; Springbrook area, December.

Biology.

In the southern part of Australia, the females feed rapidly on human blood, attacking particularly the ears, and sometimes being very annoying. In the north, they are less obtrusive, although the early stages are sometimes abundant. Larvae and pupae are found in clear, moderately swift to quite gently flowing water, usually attached to reeds, though sometimes on stones. They are common in water which is unpleasantly cold to work in.

Austrosimulium torrentium Tonn. var.

New distribution.—New South Wales: Shoalhaven River, April (McMillan); Kedumba Creek, Jamieson Valley, September (McMillan); Bellingen River, North Coast, September; Macdonald River, near Bendemeer, September; Pinch Creek, Dorrigo Plateau, January. (Previously known only from A.C.T. and Mt. Kosciusko.)

This form is so constant, and we have now seen it from so many localities, that we wonder what its status should be, although we can still distinguish it only as a full-grown gill-spot larva.

Conclusion.

Experience over the past two years suggests that it may be a long time before we can fill the gaps in our knowledge of the Cnephias, or review effectively the Simuliid faunas of Western Australia and the Northern Territory. We would therefore conclude this part with a revised table summarizing the present state of our knowledge. We have omitted the species from New Guinea and New Zealand, about which we have no new information, and we have also omitted those from the Northern Territory. At least four species of *Simulium* occur there, *S.* ? *faheyi* Tayl. and sp. *B*, known only from adults, and an undescribed representative of each of the *peregrinum* and *clathrinum* groups, known only from larvae.

References to earlier papers are given in the two previous parts of the series (These Proceedings, 73: 372–405, 1949, and 75: 167–187, 1950).

The Australian Simuliidae.

Stages Known.				Species.	Distribution.					
Larva.	Pupa.	♂	♀		Qld.	N.S.W.	Vic.	Tas.	S.A.	W.A.
				CNEPHIA						
				aurantiacum group						
x	x	x	x	*strenua* M. & M.	x					
x	x	x	x	*aurantiacum* (Tonn.) ..	x	x	x	x		
x	x	x	x	*tonnoiri tonnoiri* (Drum.) ..						x
x	x	x	x	*tonnoiri orientalis* M. & M.	x	x	x	x		
x	x	x	x	*tonnoiri fuscoflava* M. & M.	x					
(? x)			x	*umbratorum* (Tonn.) ..			x			
				terebrans group						
(? x)			x	*terebrans* (Tonn.)		x	x			
			x	sp. *A*. (M. & M.)						x
			x	*fergusoni* (Tonn.)		x			x	
			x	*fergusoni* (Tonn.) var. ..						x
				SIMULIUM						
				peregrinum group						
x	x	x	x	*peregrinum* M. & M. ..	x					
				ornatipes group						
x	x	x	x	*ornatipes* Sk.	x	x	x		x	x
				clathrinum group						
x	x	x	x	*clathrinum* M. & M.	x	x				
x	x	x	x	*nicholsoni* M. & M.	x	x	x			
x	x	x	x	*faheyi* Tayl.	x					
x	x	x	x	*melatum* Wh.	x	x	x			
x	x	x	x	*inornatum* M. & M. ..	x	x				
x	x	x	x	*aureonigrum* M. & M. ..	x					
				AUSTROSIMULIUM						
				mirabile group						
x	x	x	x	*mirabile* M. & M.	x					
x	x	x		*fulvicorne* M. & M. ..	x					
x	x	x	x	*crassipes* Tonn.	x	x	x			
x	x	x	x	*montanum* n.sp.		x	x			
x	x	x	x	*cornutum* Tonn.		x	x	x		
			x	sp. *C*. (M. & M.)						x
				bancrofti group						
x	x	x	x	*bancrofti* (Tayl.)	x	x	x	x		x
x	x	x	x	*pestilens* M. & M.	x	x				
				furiosum group						
x	x	x	x	*furiosum* (Sk.)	x	x	x	x	x	x
x	x	x	x	*victoriae* (Roub.)	x	x	x	x		
x	x	x	x	*torrentium torrentium* Tonn.				x		
x	x	x	x	*torrentium hilli* M. & M. ..		x				
x	x	x	x	*torrentium* Tonn. var. ..		x				

The only eggs known are those of *Simulium ornatipes* Sk.

ORDOVICIAN STRATIGRAPHY AT CLIEFDEN CAVES, NEAR MANDURAMA, N.S.W.

By N. C. Stevens.

(With Plates iii-iv and 4 Text-figures.)

[Read 28th May, 1952.]

Synopsis.

The Cliefden Caves Limestone, which contains abundant shelly fossils of Middle Ordovician age, conformably overlies basic volcanic rocks, and is overlain by siliceous limestones and tuffs with Upper Ordovician graptolites, trilobites and brachiopods. The structure of the area is discussed, and notes on facies and facies change are appended.

Introduction.

Cliefden Caves are situated 11 miles north of Woodstock and 12 miles west-north-west of Mandurama. Previous literature on the geology of the area is mainly concerned with the limestone, which was the first limestone discovered in Australia (Oxley, 1820). Caves in the limestone were reported upon by Wilkinson (1892) and Trickett (1908). Carne and Jones (1919) mapped most of the main limestone bed, and called it the Belubula Limestone Belt.

Until recently the limestone was assumed to be Silurian, largely due to a list of fossils collected by Trickett (1908). North of the Belubula River, Booker (1950) recorded Silurian fossils from a limestone which he assumed to be continuous with the limestone at Cliefden Caves.

However, detailed mapping and further fossil collections have shown that the main limestone bed and associated strata are of Ordovician age. A preliminary note (Stevens, 1950*b*) on this occurrence was the first record of fossiliferous Ordovician limestone in New South Wales.

The nearest locality from which Ordovician fossils have been recorded is Junction Reefs, five miles to the east (Hall, 1900; Pittman, 1900), but the exact locality is in doubt.

Stratigraphy.

A generalized sequence is given in Table 1 and Text-fig. 2, the data being drawn from excellent sections along the Belubula River and tributary creeks.

Table 1.

Formation.	Lithology.	Age.
4. Angullong Tuff.	Andesitic tuffs, tuffaceous shales, calcareous tuffs, small limestone beds.	Upper Ordovician.
3. Malongulli Formation.	Laminated impure limestones, limestone, limestone breccias, tuffs and shales.	
2. Cliefden Caves Limestone.	Massive and shaly limestones.	Middle Ordovician.
1. Walli Andesite.	Andesites, basalts, spilites, tuffs and breccias.	

1. The Walli Andesite is the name given to the volcanic rocks which are the basal formation of the sequence. They are well developed between Walli and Limestone Creek, extending north to the edge of The Large Flat, and south beyond Woodstock. The width of outcrop is about four miles, but as the base is not visible and the structure is uncertain, the thickness cannot be estimated. The formation was regarded as Silurian, equivalent to the Cargo Andesite (Stevens, 1948, 1950*a*), before the Cliefden Caves area was examined.

The lavas, which make up about 70 per cent. of the formation, are mainly andesites, with some basalts and spilites. Most of the lavas are porphyritic in plagioclase (in laths up to 20 mm. in length) and some have augite phenocrysts as well. Amygdaloidal types are present, and at one locality south-west of "Cliefden" (860380)* there is a very good example of pillow-structure, with concentric rows of amygdules, radial fractures and deuteric minerals in the interstices between the pillows.

Tuffs and breccias of variable grainsize are interbedded with the lavas, especially near the top of the formation. A tuff near "Cliefden" is notable for the large rounded pebbles of porphyritic andesite it contains.

The relations between the Walli Andesite and the overlying formation, the Cliefden Caves Limestone, are best shown at the south-west corner of The Large Flat (Text-fig. 1), where breccias which overlie porphyritic andesite pass upwards into tuffs, calcareous tuffs, and limestone containing large brachiopods. The same conformable relations hold between the main mass of volcanic rocks and the overlying limestone south and south-west of "Boonderoo" homestead, though the outcrops are not so good.

2. The Cliefden Caves Limestone is the main limestone belt, taking its name from Cliefden Caves, situated in the more massive parts of the formation on the south side of the Belubula River (863482). The limestone occurs in two arcuate (equivalent) beds which, through faulting and folding, join near Copper Mine Creek. The formation occurs mainly between the Belubula River and the Mandurama-Canowindra Road, and reaches its maximum development on the Belubula River in the north-east.

The Cliefden Caves Limestone could be divided into two or possibly three members, as shown by the section on the east side of The Large Flat (Text-fig. 1). However, in other places the lower shaly beds thin out, and it is not easy to distinguish them, so that it is more convenient to map the limestone as one formation.

The lowest bed of the Cliefden Caves Limestone contains abundant and closely-packed large brachiopods, which may be a new genus of the Trimerellacea. The shaly limestones which make up the lower part of the formation are interbedded with more massive limestones in beds 8 to 30 feet thick. All these shaly limestones are richly fossiliferous. Some of the limestone in the first 50 feet of the formation is built almost entirely of corallia of primitive Tabulata (*Tetradium*, and forms like *Proheliolites*, *Foerstephyllum*, and *Lyctophora*). These corals are most abundant on Fossil Hill (on the south side of The Large Flat), but are also found in a corresponding stratigraphical position (above the *Trimerella* bed) in the southern limestone belt beside the road from "Boonderoo" to "Kalimna". Near the top of the shaly limestones, well-preserved brachiopods are particularly abundant, associated with trilobites, gastropods and bryozoa. From these beds Dr. Opik has identified the following forms:

Brachiopoda—*Rhynchotrema*, Orthidae (two genera), Syntrophiidae (one genus), *Camerella*, *Spanodonta*, *Rafinesquina*, *Protozyga*;

Trilobitae—Asaphidae (two forms), Pliomeridae, *Encrinurella*, *Lichas*, *Trinucleus*, *Remopleurides*;

Gastropoda—*Lophospira*, *Hormotoma*, *Raphistomina*, *Raphistoma*, *Maclurites*, *Phragmolites*;

Bryozoa—*Pachydictya*, *Rhinidictya*, two of three genera of Trepostomata;

Coelenterata—Heliolitids, *Streptelasma*;

Nautiloidea—several coiled and straight forms;

Ostracoda—four genera.

These shaly beds, the lower part of the formation, are well-developed in only two restricted areas: between Fossil Hill and the Cliefden Caves near the crest of the more northerly plunging anticline, and in a similar position to the south near the road crossing of Davy's Creek. The sequence and fossils are the same in both places, so there is no doubt that the limestones are equivalent, and as both limestones overlie volcanic rocks conformably, then the volcanic rocks in both areas are of the same age.

* Military map grid co-ordinates, Canowindra 1 inch sheet.

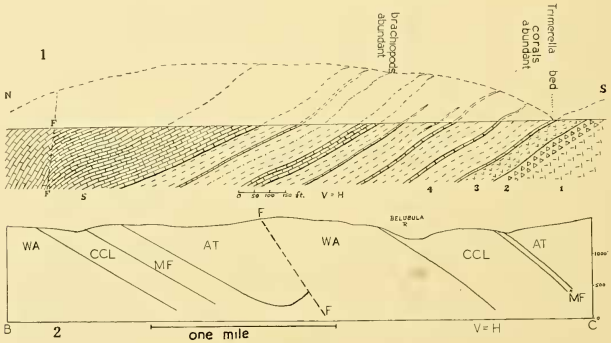
In addition to these two localities, the *Trimerella* bed has been found at the base of the limestones on Licking Hole Creek, and the coral beds occur near the base of the limestone north-west of "Boonderoo" (874467) and west of "Cliefden".

The maximum thickness of these shaly limestones is 480 feet on the eastern side of The Large Flat.

Thick massive limestones overlie the shaly members, reaching their maximum thickness (about 2000 feet) east of Cliefden Caves. In the section illustrated in Text-fig. 1, a fault interrupts the sequence, so that only 360 feet of massive limestone is shown.

The upper part of this member contains cherty siliceous nodules arranged in regular bands parallel to the bedding. Many, if not all, of these nodules are partly or wholly silicified fossils (corals). Fossils are not so abundant as in the shaly limestones, but include many of the same forms. A coral, *Favistella*, is most prominent, especially in the limestone on Licking Hole Creek.

A thin limestone bed on the west side of Limestone Creek, east of "Boonderoo", has been grouped with the Cliefden Caves Limestone, although it appears to overlie strata which are elsewhere above it. This may be due to faulting.



Text-fig. 1.

Section through the Cliefden Caves Limestone, east side of The Large Flat. 1, Porphyritic andesite; 2, breccia; 3, calcareous tuffs; 4, shaly limestone; 5, massive limestone.

Text-fig. 2.

Diagrammatic section BC (see Plate iii). WA = Walli Andesite; CCL = Cliefden Caves Limestone; MF = Malongulli Formation; AT = Angullong Tuff; F-F = Fault.

3. The Cliefden Caves Limestone is conformably overlain by the Malongulli Formation, which takes its name from the Parish and the hill around which the formation is well developed.

The formation consists mainly of impure siliceous limestones with some tuffs, shales and limestone breccia.

When fresh the impure limestones are fine-grained, black, hard, laminated, "cherty" rocks, composed of calcium carbonate (about 55 per cent.) and silica, with a little iron and alumina. The silica is in the form of sponge spicules. The fresh rocks occur along the river and major creeks, but rocks of the same formation occurring on the tops of hills present a very different appearance. They are grey in colour, less dense, and split more readily along the bedding. The lighter-coloured rocks have had calcium carbonate leached out of them and consist largely of sponge spicules.

Other fossils present are graptolites, brachiopods, trilobites and gastropods. The graptolites (determined by Mrs. K. M. Sherrard) include *Glyptograptus teretiusculus*, *Dicranograptus zic-zac* var. *minimus*, (?) *Thamnograptus* and *Climacograptus* cf.

antiquus. Opik notes also *Dicellograptus* and perhaps *Climacograptus bicornis*. These graptolites belong to the zone of *Nemagraptus gracilis*, zone 9 of the British succession, i.e., the lowest part of the Upper Ordovician. Trilobites are relatively abundant in some places (844468, 828453), and include *Trinucleus*, *Dionide*, *Remopleurides*, *Encrinurella*, and *Ceraurus*. Small Sowerbyellids, *Pseudolingula* and (?) *Chonetoidea* are the brachiopods present.

Beds of limestone breccia occur near the top of the Malongulli Formation, overlying the laminated impure limestones. The sequence along the river at the western edge of The Large Flat is as follows (Text-fig. 3, A):

7. Tuffs.
6. Impure limestones.
5. Laminated siliceous limestones.
4. Limestone breccia.
3. Laminated siliceous limestones.
2. Brown clayshales and tuffs.
1. Cliefden Caves Limestone.

A number of limestone beds of varying size occur in the Malongulli Formation between Copper Mine and Sugarloaf Creeks. They are normal, massive limestones without many fossils, except near Copper Mine Creek, where gastropods are abundant.

Massive and impure laminated limestones are associated with fine tuffs south of The Sugarloaf (Malongulli Trig. Station). The relation of these rocks to the strata further north is obscured by an intrusion, but the graptolites *Nemagraptus explanatus* var. *pertenuis* and *Climacograptus* cf. *antiquus* show that they belong to the same zone as the beds nearer the river. Graptolites (including *Amplexograptus*) have also been obtained from a similar banded limestone, which occurs as fragments in a limestone breccia at the north-east end of The Large Flat (856482).

4. The Angullong Tuff is the next youngest formation; it is named after "Angullong" property (north of the Belubula River), where it is well developed, but it also occurs between the Belubula River and Licking Hole Creek, and north and east of "Boonderoo".

The relation with the underlying formation is best seen along the northern bank of the river at the north end of The Large Flat. A conformable passage from impure black limestone to tuff occurs.

The rock types of this formation are chiefly andesitic tuffs, with calcareous beds, small limestone lenses, and possibly some minor andesite flows (it is not yet certain whether the latter are flows or sills).

Well-bedded tuffaceous shales and banded tuffs occur along the river between "Kalimna" and the Upper Devonian quartzite gorge of The Needles. Diplograptid graptolites are present in calcareous beds associated with these tuffs west of "Kalimna" (830485 and 833494).

The similarity in lithology between the tuffs near "Boonderoo" and those north of the river, together with the fact that they both overlie the Malongulli Formation, leaves little doubt that the tuffs are of the same formation. East of "Boonderoo" the junction of the Malongulli Formation with the Angullong Tuff is irregular, as the upper beds of the Malongulli Formation grade laterally into tuffs over a short distance.

The Angullong Tuff appears to dip beneath limestone one mile north-north-east of "Kalimna". The limestone is possibly of Silurian age, as *Halysites* and *Heliolites* have been found in it further north, as well as poorly preserved compound corals at its southern end. It is probable that this is the limestone in which *Conchidium* was also found (Booker, 1950). It adjoins the Cliefden Caves Limestone at one place, and probably overlies it unconformably.

On the eastern side of Limestone Creek also, the Angullong Tuff seems to dip beneath limestone (three-quarters of a mile south of the Belubula River). This limestone is massive and unfossiliferous, and may be of Silurian age.